

Motility of Mouth & Esophagus

1-Mastication (Chewing):

- The teeth are admirably designed for chewing, the anterior teeth (incisors) providing a strong cutting action and the posterior teeth (molars) a grinding action. All the jaw muscles working together can close the teeth with a force as great as 25 kg on the incisors and 90 kg on the molars.
- Most of the muscles of chewing are innervated by the motor branch of the **fifth cranial nerve**, and the chewing process is controlled by **nuclei in the brain stem**.

Much of the chewing process is caused by **the chewing reflex (stretch reflex)**, which may be explained as follows:

- * Entry of a bolus of food to the mouth causes descend of lower jaw and stretch of the muscles of mastication which in turn initiates a stretch reflex of the jaw muscles that leads to contraction.
- This automatically raises the jaw to cause closure of the teeth, but it also compresses the bolus again against the linings of the mouth, which inhibits the jaw muscles once again, allowing the jaw to descend; and this is repeated rhythmically.

Importance:

- It breaks large food particles into smaller ones.
- Stimulates taste buds & smell receptors leading to satiety.
- Stimulates salivary secretion which helps swallowing.

2-Swallowing (Deglutition)

Definition: Is the process by which bolus of food moves from the mouth into the stomach.

Swallowing is divided into three stages:

- (1) **The oral stage**, when food move from mouth to pharynx.
- (2) **The pharyngeal stage**, constitutes the passage of food through the pharynx into the esophagus.
- (3) **The esophageal stage**, involves passage of food from the esophagus to the stomach.

(1) Oral Stage of Swallowing:

It is the voluntarily stage. The bolus is squeezed or rolled posteriorly into the pharynx by pressure of the tongue upward and backward against the hard palate by contraction of mylohyoid muscle.

(2) Pharyngeal Stage of Swallowing:

It is voluntary phase. As the bolus of food enters the pharynx, it stimulates **swallowing receptor** areas around the opening of the pharynx, especially on the tonsillar pillars, and impulses from these pass to the deglutition center in **the medulla and lower brain** to initiate a series of **automatic pharyngeal muscular contractions** that begin in the superior part and spreading downward as a rapid peristaltic wave over the middle and inferior pharyngeal muscles, which propels the food into the esophagus (**Fig 1**).

Return of the bolus back into the mouth is prevented by position of the tongue against the soft palate (roof of mouth).

Protection of the air passages occurs during swallowing as following:

1-The soft palate is elevated close the posterior nares to prevent passage of bolus from pharynx into nasopharynx.

2- Elevation of larynx to be covered by epiglottis.

3- Closure of glottis (approximation of vocal cords).

2 and 3 prevent passage of food into the larynx.

4- Inhibition of respiration (swallowing apnea).

The entire pharyngeal stage of swallowing takes in 1 to 2 seconds, interrupting respiration

The swallowing center inhibits the respiratory center of the medulla during this time, stopping respiration at any point in its cycle to allow swallowing to proceed.

The upper esophageal or pharyngoesophageal sphincter relaxes, allowing food to move easily and freely from the pharynx into the upper esophagus.

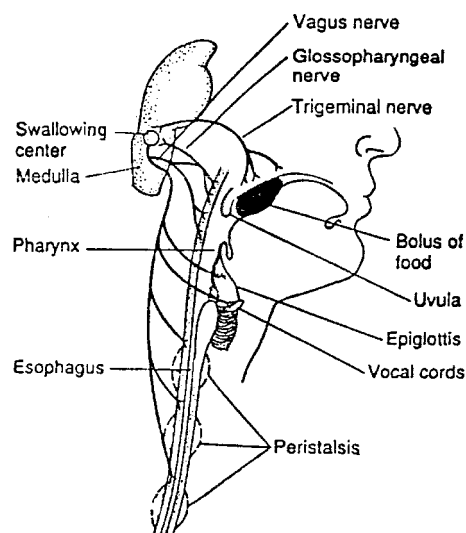


Fig. (1): The swallowing mechanism.

Nervous control of the pharyngeal stage of swallowing:

-The areas in the medulla and lower pons that control swallowing are collectively called the deglutition or swallowing center.

-The pharyngeal stage of swallowing is principally a reflex act. It is almost always initiated by voluntary movement of food into the back of the mouth, which, in turn, elicits the swallowing reflex.

(3) Esophageal Stage of Swallowing:

It is the second involuntary stage. The esophagus functions primarily to conduct food from the pharynx to the stomach, and its movements are organized specifically for this function.

Normally the esophagus exhibits two types of peristaltic movements, primary peristalsis and secondary peristalsis.

Primary peristalsis is simply a continuation of the peristaltic wave that begins in the pharynx and spreads into the esophagus during the pharyngeal stage of swallowing.

This wave passes all the way from the pharynx to the stomach in approximately 8 to 10 seconds.

However, if the primary peristaltic wave fails to move all the food that has entered the esophagus into the stomach, **secondary peristaltic waves** result from distention of the esophagus by the retained food, and they continue until all the food has emptied into the stomach.

These secondary peristaltic waves are initiated **partly by** intrinsic neural circuits in the esophageal enteric nervous system, and **partly by** reflexes that are transmitted through vagal afferent fibers from the esophagus to the medulla and then back again to the esophagus through vagal efferent fibers.

Function of the lower esophageal sphincter (gastro-esophageal sphincter) (LES):

The LES is made up of three components:

1-The esophageal smooth muscle is more prominent at the junction with the stomach (**intrinsic sphincter**).

2-Fibers of the crural portion of the diaphragm, a skeletal muscle, surround the esophagus at this point (**extrinsic sphincter**)

-The intrinsic and extrinsic sphincters operate together to permit orderly flow of food into the stomach and to prevent reflux of gastric contents into the esophagus.

3-In addition, the oblique fibers of the stomach wall create a flap valve that helps close off the esophagogastric junction and prevent regurgitation when intragastric pressure rises.

This sphincter remains tonically contracted, in contrast to the mid and upper portions of the esophagus that normally remain completely relaxed. **Only** when a peristaltic swallowing wave passes down the esophagus, "**receptive relaxation**" relaxes the lower esophageal sphincter ahead of the peristaltic wave and allows easy propulsion of the swallowed food into the stomach.

The tone of the LES is under neural control:

- a. **Acetylcholine** released from vagal nerve endings causes contractions of LES.
- b. **Nitric oxide (NO) and VIP** from interneurons innervated by other vagal fibres cause it to relax.

*Between meals the normal tonic activity of the lower esophageal sphincter prevents reflux of stomach contents into the esophagus.

Abnormalities of the tone of LES:

- 1- If resting tone of lower esophageal sphincter is decreased, reflux of the gastric acid content into the esophagus (**gastroesophageal reflux**) will cause heartburn and oesphagitis and can lead to ulceration and stricture of the esophagus due to scarring.

Tone of L.E.S. is decreased during pregnancy by the high level of progesterone leading to some degree of reflux and heartburn. Also diet with high sugar and fat may lead to heartburn.

- 2- **Achalasia:** It is incomplete relaxation of the LES which leads to accumulation of food in the esophagus and its massive dilation.

The myenteric plexus of the esophagus is deficient at the LES in this condition and the release of NO and VIP is defective.

- It is treated by dilation of the sphincter, esophageal muscle incision or by injection of botulinum toxin in the LES to inhibit acetylcholine release.